

QUASI SPHERICAL FUEL COMPRESSION AND FAST IGNITION WITH ION-BEAM DRIVEN ONE-SIDED X-TARGET ILLUMINATION

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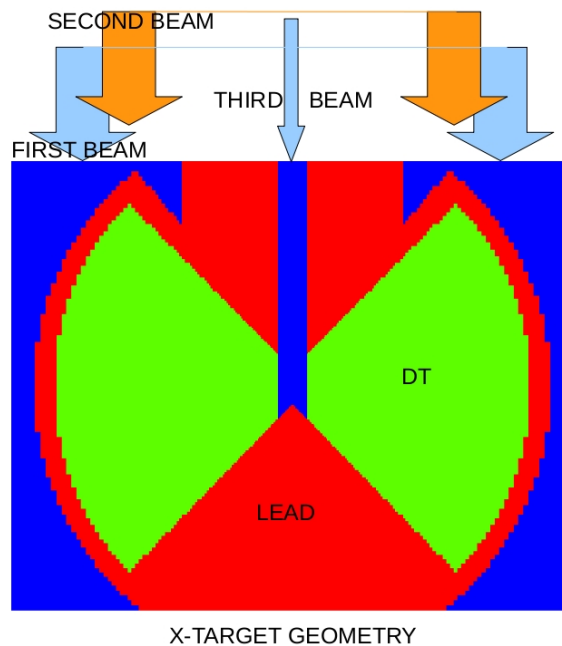
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One-sided axial target illumination using annular and solid heavy ion beams has been investigated for compression and fast ignition of a quantity of DT enclosed in a high density metal case with a cross section in the shape of an “X” (X-target). Quasi 3-D fuel compression of the DT fuel is obtained by optimizing the geometry of the case, as well as the timing and aiming of two annular ion beams, and controlling the hydro-effects of beams heating the case as well as the fuel. The target geometry is obtained by removing two 45 degree half-angle cones from opposite sides of an otherwise spherical DT ball of 4 mm radius. This X-shaped fuel is enclosed in a 0.5 mm thick high density case made of copper, lead or gold. The ion beams used to compress the fuel are 0.5 MJ and 1.5 MJ, 60 GeV, 25 ns uranium beams; the first with 3 mm and 4.4 mm, and the second with 2 mm and 3.4 mm inner and outer radius respectively. The deposited energy in the metal case of these “compression” annular beams is converted into axial or spherical pistons which drive a quasi-spherical implosion. Our initial simulations have achieved a compression ratio of ~ 100 , from an initial DT density of 0.25 g/cc to a final density of about 25 g/cc and confinement parameter ρR of about 1 g/cm²; work in progress is directed towards achieving higher densities in excess of 50 g/cc. At full compression, a third “ignition” annular or solid beam is injected through a 600 microns diameter channel to compress and heat the fuel to thermonuclear conditions and start burn propagation. This fast ignitor beam is also a 60 GeV uranium beam with a pulse length of 50 ps. This design has not been optimized and still represents work in progress. The X-target has the potential for simple target fabrication, robust stability (low convergence-ratios), high gain at low fuel densities[1] and relatively negligible RT-mix effects. We will present radiation hydrodynamics calculations including thermonuclear burn obtained with the HYDRA code.



References

1.- J.H. Nuckolls, IFSA2009_”Grand Challenges of IFE”_LLNL-JRNL-418569V4.

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